POLLEN ANALYSIS OF A MARL POND, NEWAGO COUNTY, MICHIGAN

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Abstract

A pollen analysis was made from Marl pond, Newago County, Michigan. This site was chosen because of its proximity to relic prairie areas in the southeastern part of the county. These prairie areas have not contributed to the regional pollen deposition at the core site, and because of this the investigator was unable to date the time of origin of these prairies in Newago County.

The Marl Pond diagram does not show the effects of the last glacial fluction in west-central Michigan as seen at Mud Lake, Newago Co. A carbon 14 date from Mud Lake dates the Valders Readvance at 11,550 years before the present. The Pine Pollen Zone which followed the Valders Readvance marks the beginning of the postglacial time and was radiocarbon dated at 10,300 years before present at Marl Pond. This paper gives an indication of the late- and postglacial floristic changes in Newago Co., Mich.

INTRODUCTION

This paper is a continuation of work started in the summer of 1968 by James A. Ogg and the author, at which time our objectives were twofold: (1) to attempt to find the time and origin of the relic prairie areas in Newago County, and (2) to provide a late and postglacial pollen diagram from an area close to the Valders Readvance maximum (Ogg and Leach,1968). This paper supports and extends the data from Mud Lake, Newago County.

For this analysis a marl pond was chosen, located in Newago County (SW¼, SE¼, SE¼, Sec. 2, T 12 N, R 12 W, Brooks Twp.; Long 85 40' 30" W; Lat. 43 27' 20" N) four miles (6.8 km.) north-northwest of Mud Lake. This site is immediately on the north edge of a relic prairie area, and is surrounded by the original "west prairie" noted in the surver's records; it should have received the regional pollen deposition from this area.

Newago County is located in the western, central part of the lower Peninsula of Michigan. The coreing site is 35 miles (56 km.) from Lake Michigan and 31 miles (49 km.) from the Valders Readvance maximum (Fig. 1). The pollen diagram from Mud Lake showed the Cary Retreat, Two Creeks Interstadial, and Valders Advance (Ogg and Leach, 1968). The Cary Retreat peroid was shown in high Picea pollen, Artemisia pollen, and NAP. The Two Creeks Interstadial showed low Picea pollen and high Pinus pollen, with an increase in hardwoods. The Valders Readvance showed an increase in Picea pollen and a decrease in Pinus pollen, with Abies increasing to its masimum (Ogg and Leach,1968).

The prairie areas in Newago County are the most northeasterly outliers of the Prairie Peninsula which extended around the tip of Lake Michigan into southwestern Michigan (Veatch, 1927; Transeau, 1935).

Various studies of the Prairie Peninsula in the southern Great Lakes states have given rise to interpretations of the origin (Transeau, 1935; Benninghoff, 1964) and the ecological requirements of these treeless areas (Veatch, 1928). Hauser (1953) did an ecological study on these relic praires in Newago County, especially as related to soil types. The eight original prairie areas in the county are mostly or entirely located on Sparta loamy sand (Mick, 1951). These areas have endemic prairie species growing on them. Included are such species as Andropogon scoparius (little bluestem), Andropogon Gerardi (big bluestem), Artemisia (wormwood), Solidago tenuifolia (prairie sunflower), Lupinus perennis (prairie lupine), Potentilla arguta (cinquefoil), and Opuntia perennis (cactus).

METHODS AND MATERIALS

Collection of Sediments

On September 7,1968 a core was taken from the pond to see if the basin contained late glacial pollen in its lowermost sediments. A 1 in. Livingstone sampler was used and a 237 cms.-long core was obtained. Spot processing and examination showed there was good representation of pollen in the sediments. On October 10, 1968 another core was taken, this time with the 2 in. Livingstone sampler. A total of 465 cms. af sample were taken. The core was taken back to the lab where it was cut in half, one half supplying the material for this study, and the other half laid out and photographed. Sampling the core was done in 5 cms. intervals for the top 300 cms. and at 2.5 cms. intervals for the area between 300 cms. and 465 cms. The remaining bulk of the core, to be used in studying the macrofossils, was seperated into 15 cms. interval units for storage.

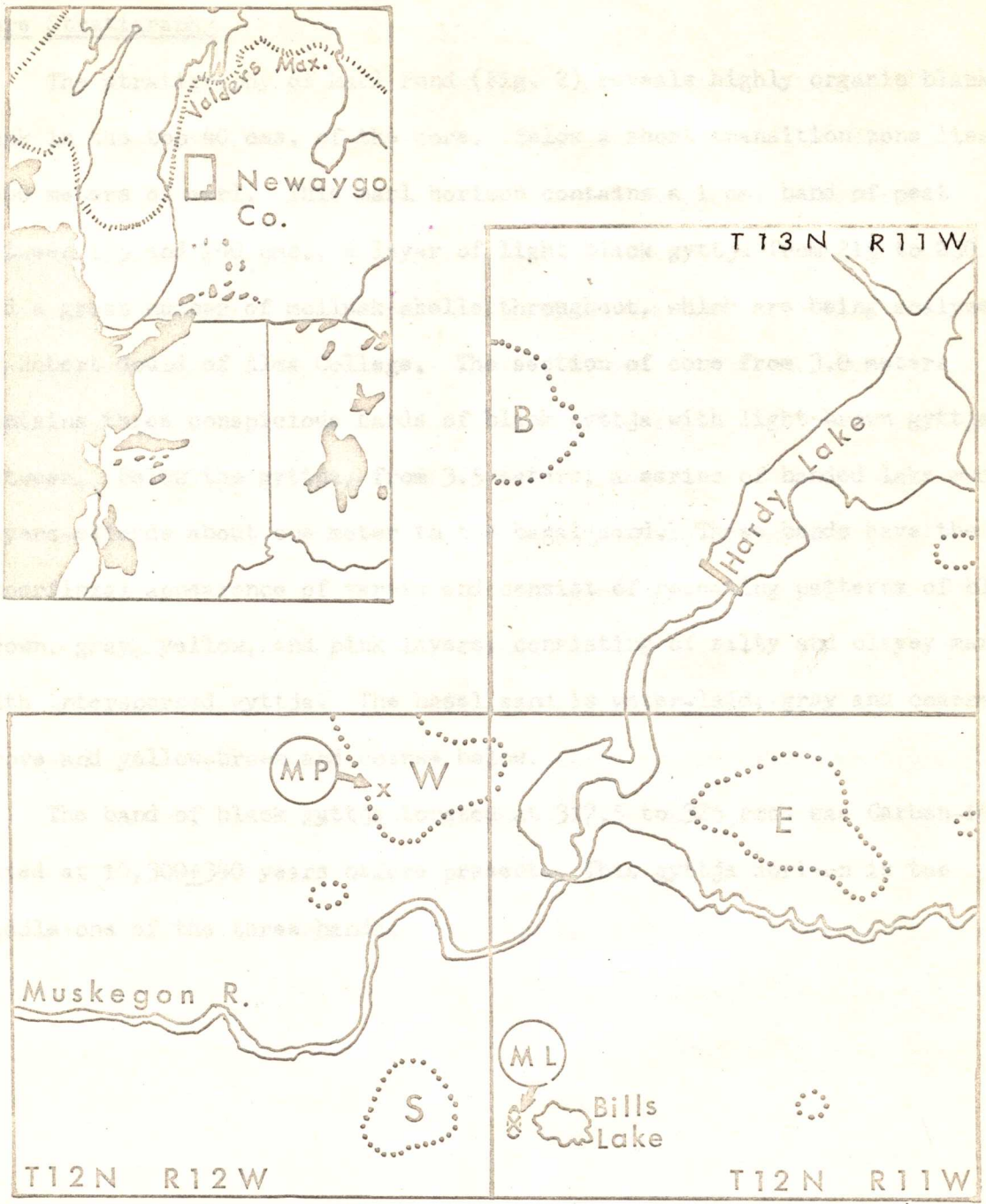

Fig. I. Location map, the Prairie Peninsula showed in darkened areas. The enlarged map represents the southeast corner of Newago County. The relic prairie areas are enclosed by dotted lines -- Big Prairie (B), West Prairie (W), South Prairie (S), and East Prairie (E). The two pollen diagrams from this area are Marl Pond (MP) and Mud Lake (ML).

Core Stratigraphy

The stratigraphy of Marl Pond (Fig. 2) reveals highly organic black muck in the top 40 cms. of the core. Below a short transition zone lies 2.60 meters of marl. This marl horizon contains a 1 cm. band of peat between 135 and 140 cms., a layer of light black gyttja from 215 to 230 cms., and a great number of mollusk shells throughout, which are being analyzed by Robert Gould of Alma College. The section of core from 3.0 meters contains three conspicious bands of black gyttja with light brown gyttja between. Below the gyttja, from 3.5 meters, a series of banded lake mud layers extends about one meter to the basal sand. These bands have the superficial appearence of varves and consist of repeating patterns of black, brown, gray, yellow, and pink layers, consisting of silty and clayey marl with interspersed gyttja. The basal sand is water-laid, gray and coarse above and yellow-brown and coarse below.

The band of black gyttja located at 317.5 to 325 cms. was Carbon-14 dated at 10,300±340 years before present. This gyttja horizon is the middle one of the three bands.

Sample Preparation, Pollen, and Analusis

The sediments were prepared for microscopic work by using Erdtman's processing method (Brown, 1960). This included the use of 6% HCl for the removal of calcareous sediments, 10% KOH treatment, acetolysis, and suspension in glycerin jelly.

Leitz binocular microscopes were used in the identification and counting of pollen. The microscopes were fitted with a calibrated mechanical stage which enabled counting non-overlaping transects and aided in the relocation of undetermined grains. Scanning was done at 450X while oil immersion (1000X) was used for close inspection of the grain. Alma College's pollen reference collection and several keys were used in the identification of the pollen and spores.

The pollen was divided into four categories: Arboreal Pollen (AP), Non-arboreal Pollen (NAP), undetermined pollen grains (which were broken or unrecognizable), and unknown objects which could not be identified as being pollen or spores. At each level examined 200 to 400 grains were counted, except in the basal sands. The AP, NAP, and undetermined pollen grains made up the total pollen percentages used.

Pollen Stratigraphy

The pollen diagram (Fig. 2) may be divided into four zones: (1) the Lateglacial Spruce Pollen Zone, (2) the Pine Pollen Zone, (3) the Postglacial Hardwood Pollen Zone, and (4) the Agriculture Pollen Zone. The first three zones are approximately equivalent to zones A, B, and C established by Wright et. al. (1963) in their synopsis of late- and postglacial vegetational history. Wright did not establish an agricultural zone.

The Spruce Pollen Zone cannot be readily subdivided into subzones in this diagram. It is characterized throughout by over 40% Picea pollen, less then 20% Pinus pollen, small persentages of Larix, Fraxinus, Betula, and Populus. Abies markes two peaks of over 25% pollen, one at 425 cms. and one at 360 cms. Artemisia pollen is abundant and peaks at 22%. This zone represents the cold, moist climate associated with the proximity of the glaciers. The Valders stadial has a well documated average date of 11,850 years B.P. Ogg and Leach (1968) have a radiocarbon date from the uppermost part of the spruce zone in Mud Lake, Newago County, of 11,500± 400 years B.P. This helps support the authors hypothesis that the spruce pollen zone represents the effects on the vegetation in the Marl Pond area by the Valders stadial.

The Pine Pollen Zone is characterized by at least 40% Pinus pollen, with a maximum of 62%; a rapid decrease in Picea and Abies to a minimal influence; a peak in Ulmus in the middle of the zone; a steady increase in Quercus to 17%; and a decrease in NAP. The middle of the three black gyttja horizons from the core, corresponding with the peak in Pinus, was radiocarbon dated at 10,300±340 years B.P. This confirms the date of termination of the spruce pollen zone. One meter of sediments (250 to

350 cms.) compose the pine zone.

The Hardwood Pollen Zone extends upward from 2.5 meters. The shift to the hardwood zone is very gradual. Pine pollen does not decrease as rapidly or to as low a percentage as seen in the Mud Lake pollen diagram (Ogg and Leach, 1968); correspondingly, the peaks of Quercus and other hardwood pollen are not prominent. Quercus rises to over 25%; Pinus gradually diminishes; Acer, Betula, Fraxinus, and Ulmus show stable percentages; while Tsuga and Fagus are late comers into the area.

The Agricultural Pollen Zone at the surface (top 20 cms.) of the sediments shows the effect of forest clearance on the pollen record. Ambrosia, Artemisia, and non-arboreal pollen rise, while that of the major trees in the pollen record decline. Pinus is an exception, as it rises, probably due to the pine plantations which have taken much of the open, sandy prairie areas. Cupressaceae and Populus have not been emphasized in the zonal descriptions because of poor preservation and problems in differentiation of these two pollen types.

Paleoecological Inferences

Since the time of von Post's work in Scandinavian peat bogs, pollen diagrams have been accepted as useful paleoecological research tools (Davis, 1967). Nevertheless, pollen analysis has several severe limitations. Although pollen diagrams are somewhat representative of the vegetation of an area, the pollen percentages do not reflect the actual composition of the plant community with accuracy. It is known that some plants, like Pinus, are vastly overrepresented in pollen diagrams, while others, such as Acer and Tilia, are badly under-represented. Even so, the pollen diagram

does permit some tentative conclusions concerning late- and postglacial vegetation and paleoecology.

It was hoped that the Spruce Pollen Zone would show similar fluctuations of spruce and pine in response to the Two Creeks and Valders stages as are seen in the Mud Lake diagram (Ogg and Leach, 1968). But the pollen became too scarce in the sand at the base of this core, and at present does not permit a replication of the subzones as seen at Mud Lake. Although pine is present in the bottom sample counted, and absent in the two samples above, there is not enough of a change to make any definate correlation.

The two radiocarbon dates from Mud Lake (11,500 B.P.) and Marl Pond (10,300 B.P.) suggest that the transition interval from the Spruce Zone to the Pine Zone was 1,200 years long at maximum.

There is no clear-cut evidence in the pollen diagram to suggest the time of development of the "oak openings" or relic prairies in the area. The absence of any major rise in NAP, or deposition of pollen of distinctive prairie species, suggests that the prairies were never extensive enough to replace the general forest cover of the county. It is possible that the oak openings may have been restricted to the Sparta loamy sand from their earliest development. If the prairies have always been of such limited extent, one would expect the arboreal pollen types to dominate the regional pollen rain.

In general, it appears that the Prairie Peninsula served as a barrier to Tsuga and Fagus migration in early postglacial times (Benninghoff, 1963). The relic prairies in Newago County may also have a limiting effect on these trees within the county. These two species are known to be in the central Michigan area from 8,00 B.P. until the present (Gilliam, 1967; Benninghoff,

1963). Hamilton (1955) states that beech is adaptable to a great range of climatic conditions, and it will exist on a considerable range of soil conditions. It preforms best on neutral of slightly alkaline soils of high fertility with adequate moisture, but it also occurs on every type of soil from clay loam to sand. Gleason (1924) concluded that soil moisture is the controlling soil factor in determining the presence and proportion of beech. As Marl Pond is located within the area known as West Prairie with its light Sparta loamy sand, which does not hold soil moisture well, it can be reasoned that these are the reasons for the lack of Fagus from the pollen diagram.

Studies are planned to determine in detail the variations in modern pollen rain along transects from the centers of existing relic prairies into the adjacent woodlands. This may help the author to interpret the meaning of low but persistent NAP percentages through the postglacial. Continuing pollen studies, and increased familiarity with the infrequent pollen grains of indicator prairie species, may still allow the determination of the date of origin of these relic prairies.

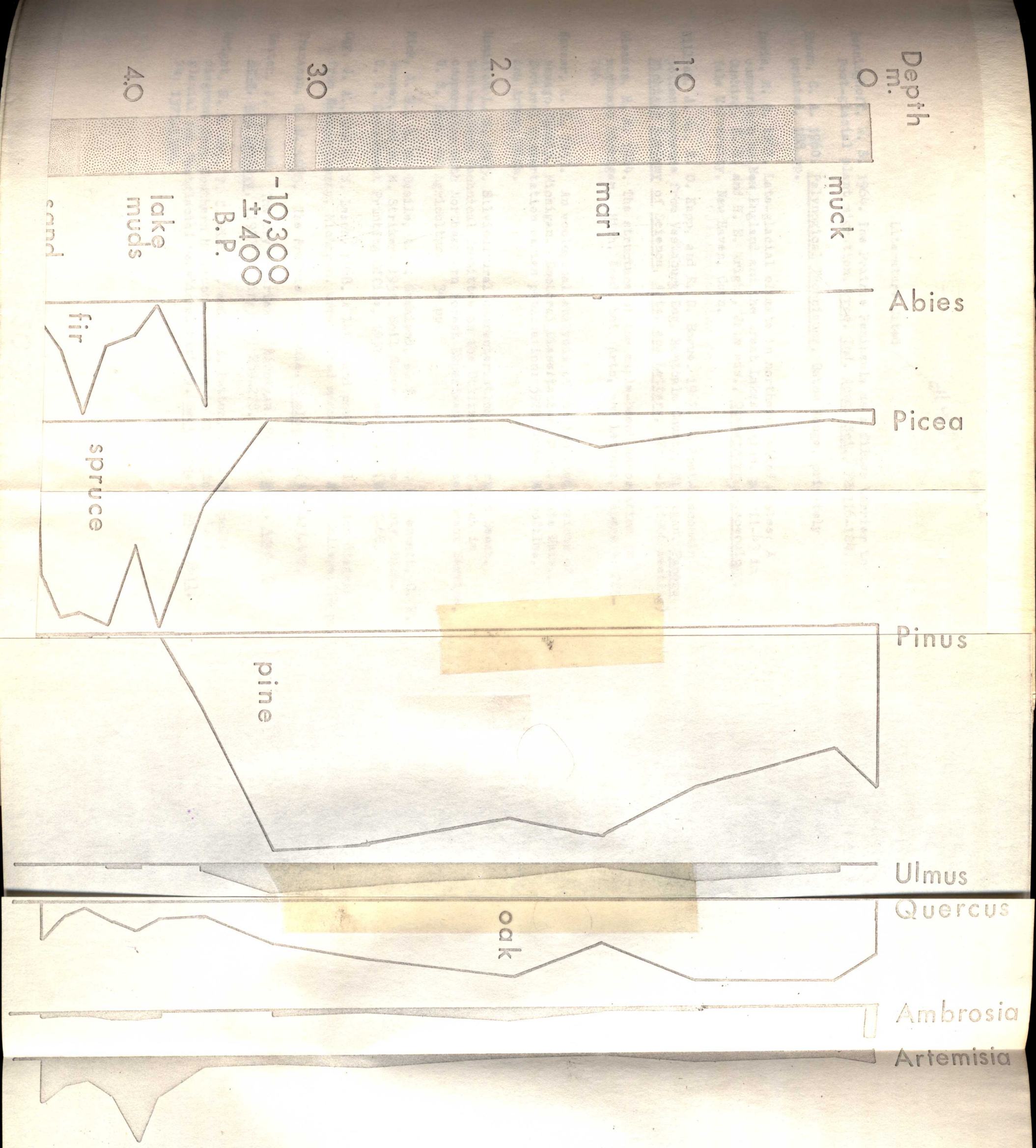

Fig. 2. An abbreciated pollen diagram showing the four major arboreal pollens at Marl pond -- Abies, Picea, Pinus, and Quercus -- and the two major non-arboreal pollens -- Ambrosia and Artemisia. The column on the left shows the stratigraphy of the core. At the right is seen the persentage diagran of AP and NAP. The N column denotes the number of pollen grains counted at each level.

all upper case

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